Network Architectures

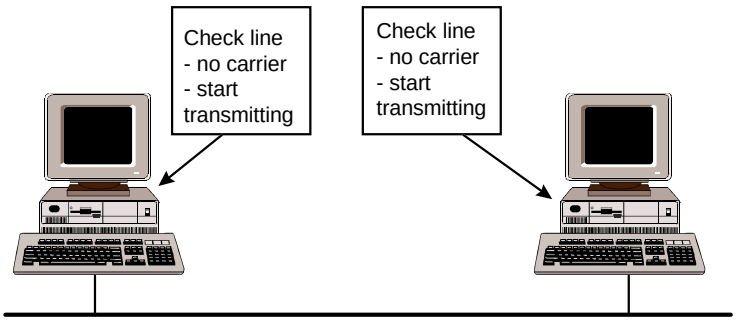
Network architecture refers to the overall design of a network, including the media access method and the physical components. Three of the most common architectures are Ethernet, Token Ring, and ARCnet.

An Ethernet network is based upon a bus topology. The physical characteristics and speed of the cabling usually distinguishes the various flavors of Ethernet. In an Ethernet Network, computers are connected to a common cable and listen for any signals on that cable before transmitting. Ethernet networks transmit only when the channel is quiet. This technique is called carrier-sense multiple access with collision detection (CSMA/CD).

Without collision detection, data signals would overlap and data would be unusable. Whenever two workstations transmit at the same time, the collision is detected, transmissions are stopped, and then transmission is retried after a sufficient time interval (millionths of a second). CSMA/CD allows relatively fast access when fewer, longer data frames are transmitted. On the down side, collision management and retransmission can degrade performance when short bursts of data are being transmitted.

Collision Detection

Step 1.



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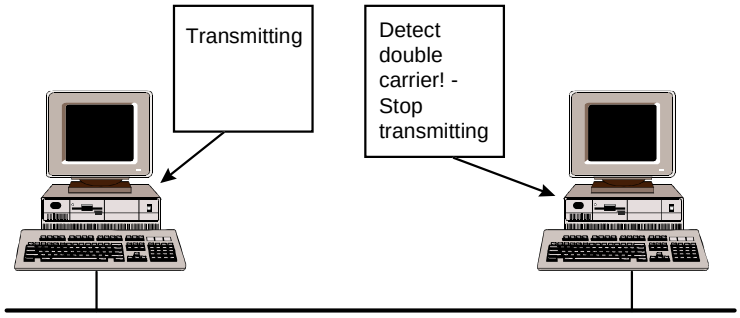

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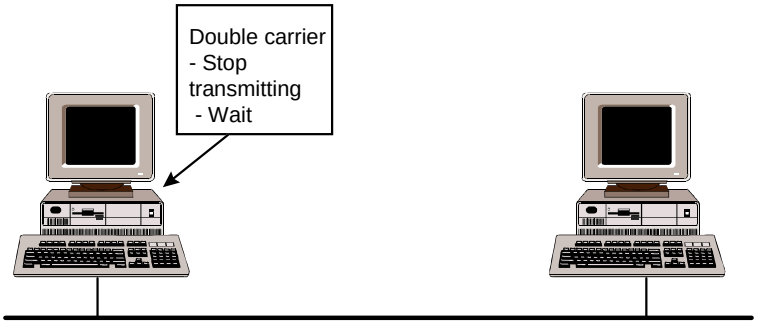

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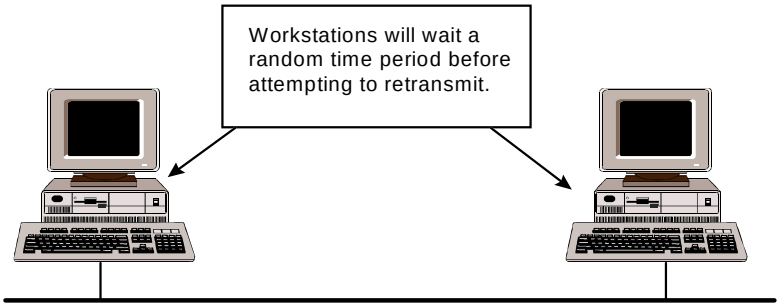


(10base2)

Thinnet gets its name from the thin coaxial cables used to connect the network. The topology is called 10base2, because it transmits at 10 Megabits per second over a baseband wire and can carry a signal roughly 2 X 100 meters (actually185). Thinnet networks are usually a local bus topology and are connected directly to the computer's network interface card using a T - connector. Thinnet is an inexpensive and economical configuration, ideal for a small department or workgroup.

Twisted Pair (10baseT)

10baseT uses an unshielded twisted-pair cable to connect workstations. The "10" indicates that the cable operates at 10 Megabits per second, and the "T" represents the "twisted" in twisted pair. The twisting cancels electrical noise from adjacent pairs and from other devices such as motors, relays, and transformers. Most networks of this type are configured in star patterns but electronically use a bus signaling system like other Ethernet configurations.

Fast Ethernet and Gigabit Ethernet

The quest for higher speed and greater bandwidth continues as never before. The Ethernet standards have answered with two additions to their original specifications: Fast Ethernet and Gigabit Ethernet.

Fast Ethernet began shipping in 1994. It is also known as 100baseT, the 100 representing 100mbps transmission speed. Gigabit Ethernet is just now being implemented. Its data rate of 1 gigabit per second is 100 times the original Ethernet speed. All three Ethernet speeds use the same frame format, duplex operation and flow control methods, which gives Ethernet networks a tremendous advantage in scalability. It is relatively easy to connect low-speed devices to the newer high-speed network using LAN switches or routers to adapt one physical line speed to the other. An upgrade to these new standards is evolutionary rather than a wholesale rebuild to the network, greatly lowering the cost of ownership. The bottom line is that Fast Ethernet and Gigabit Ethernet are still Ethernet, only faster.

Token Ring Network

A token ring network is distinguished more by its token passing access method than by the physical characteristics of its cabling. Token ring networks were first implemented in the early 1980s with the goal of providing a simple network wiring structure. In a token ring topology, computers are connected in a continuous network loop in which a token is passed from one computer to the next. The token is a data frame (or packet) which is continuously passed around the ring. In a normal transmission, a station receives the token and transmits the data frame. The receiving station receives the data frame and sends an acknowledgement. The sending station then receives acknowledgement and releases the token to the next station.

Token Ring networks are physically implemented in a star configuration but managed electronically as a ring. Workstations are in fact attached to a hub called a Multistation Access Unit (MAU).

ARCnet

ARCnet (Attached Resource Computer Network) was developed by Datapoint Corporation in 1977 and was designed as a token passing bus architecture. ARCnet is easy to install and inexpensive. It typically uses coaxial cable in a star pattern to connect to active and inactive hubs. Active hubs regenerate signals. Passive hubs split signals into smaller, weaker signals. ARCnet was originally limited by its signaling speed of 2.5 MBS until 1992, when a new version, ARCnet Plus, providing 20 MBPS throughput, was released.

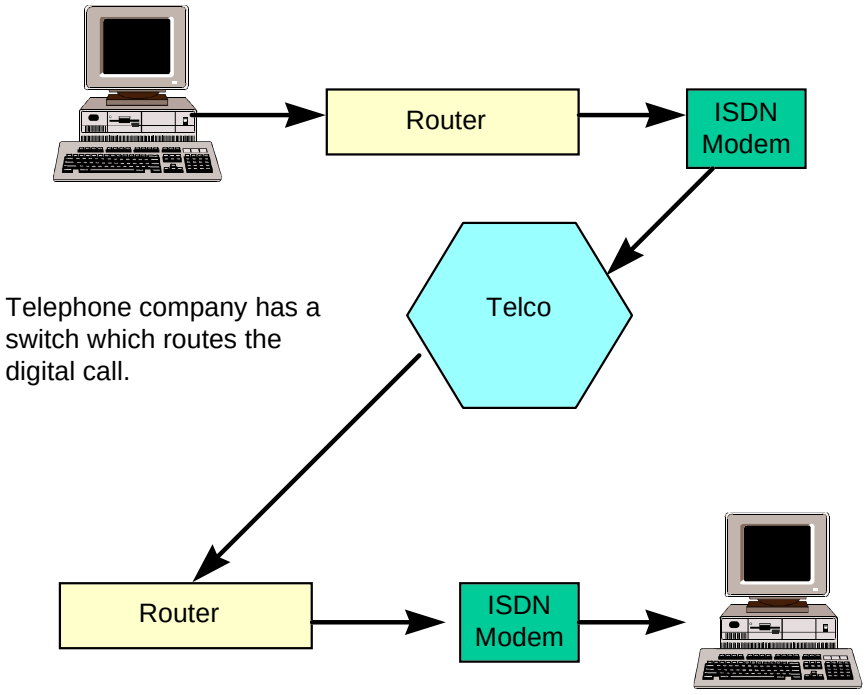
Circuit Switched Digital Services

Maintaining a reliable network that preserves data integrity can be an expensive proposition. As distances increase and greater volumes of data are pushed at higher speeds, the cost of networking rises.

An alternative to the high cost of a dedicated LAN-to-LAN network link is to dial up a digital line on an as-needed basis. Dial-up circuits are called Circuit Switched Digital Services. Circuit switched lines are much more economical if a 24-hour-a day LAN-to-LAN network line is not required. Circuit switching vendors offer signaling rates from 56kbs to 1.544Mbps.

The Integrated Services Digital Network (ISDN) is a circuit switched digital service. The most popular ISDN service is Basic Rate Interface (BRI), which uses two data channels to carry 64 KBPS each (128kbps total). The data channels are called “bearer channels” or “B channels.” There is also a “D channel,” which is used to signal computers in the switched circuit to generate, reset, and receive information. Circuit switching ISDN provides an economical way to connect to high speed LANs without the overhead of a permanent connection.

ISDN Circuit Switched Network

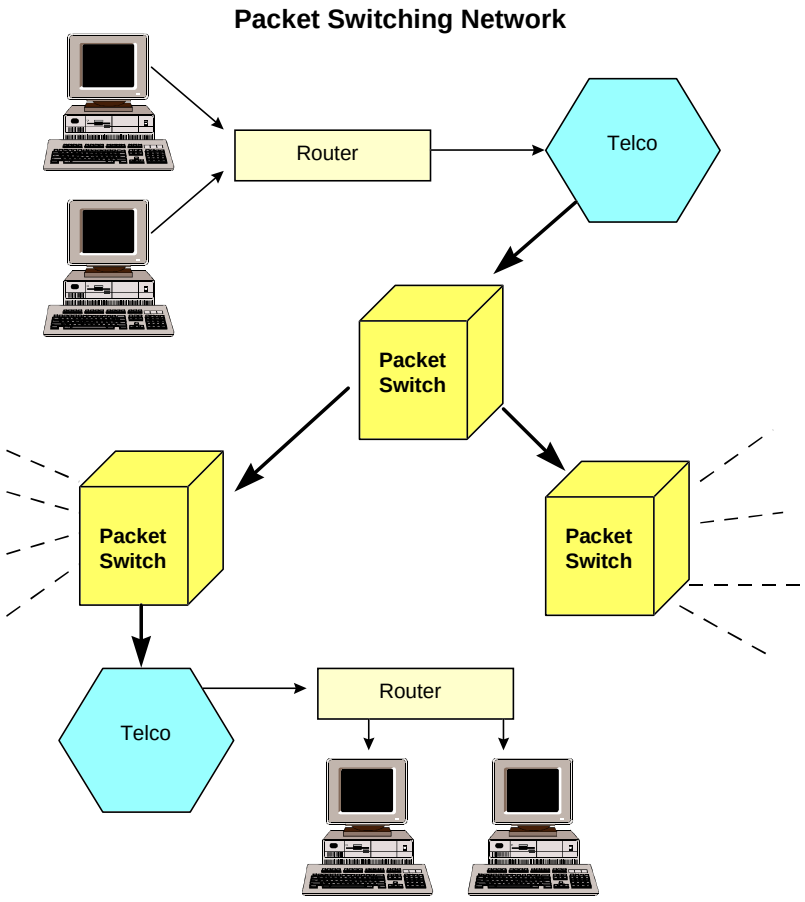


Packet Switched Networks

Packet Switched networks include X.25, Frame Relay and cell relay technologies. The major appeal of packet switching services is their flexible multipoint capabilities. LANs in various locations use different signaling rates, which create problems when trying to communicate with each other. Packet switching addresses these problems by buffering the data. Commercial packet switching networks or Value Added Networks (VANs) use packet switching because of the buffering error correction and protocol conversion it provides. CompuServe is an example of a VAN.

The X.25 protocol once dominated the packet switched network but is rarely used today. Much of the bandwidth and processing overhead has been stripped from X.25, and another service called Frame Relay was developed. Frame Relay uses variable length frames that provide flexibility but also pulls processing power from the network, as it constantly adjusts the flow and timing of the message. A much more efficient method of transporting data is to use packets of the same size. The cell relay standard, Asynchronous Transfer Mode (ATM), does just that. All ATM cells consist of 48 bytes of application data plus 5 bytes for the header. Because the cells are uniformly sized, network equipment can quickly route the data to its proper destination. ATM is often used to move large volumes of data.

Packet Switched networks are “user sensitive” in that the billing scheme is often set to actual usage of the network as opposed to a flat fee which is common in circuit switched networks. Packet switches offers reliability, flexibility, and a service paid for only when used.



Functions of a Packet Switch

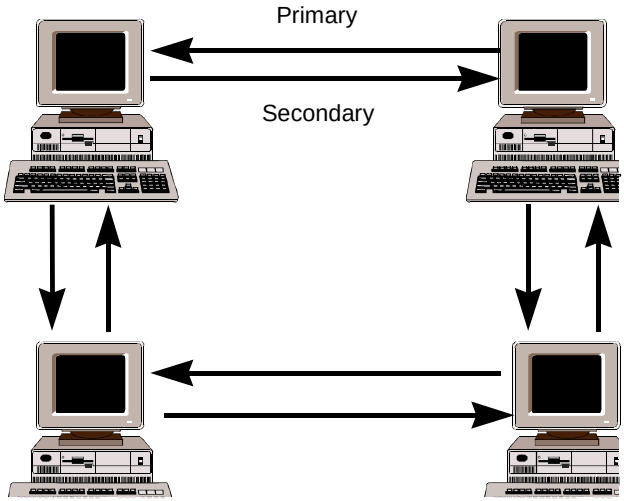
- Check validity of packet
- Check address
- Monitor traffic
- Check trouble reports
- Determine best route
- Order packets
- Retransmit on request
- Error recovery

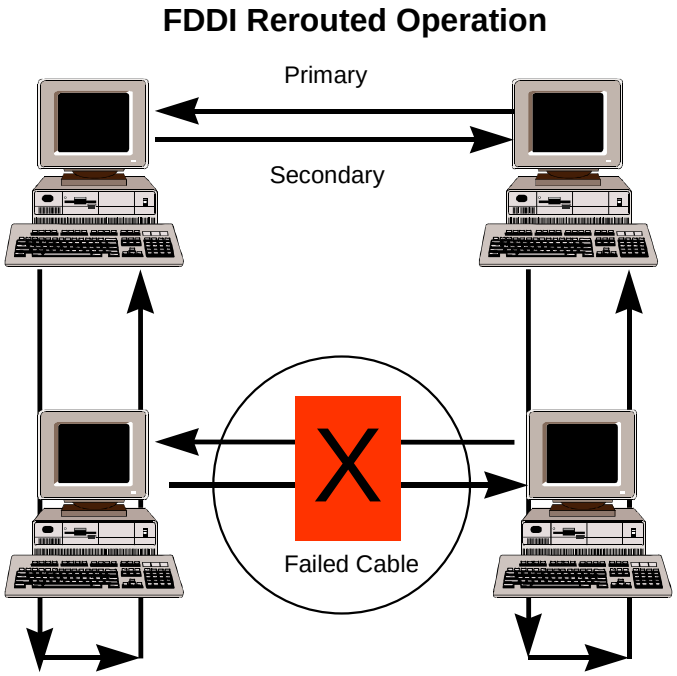
FDDI

Fiber Distributed Data Interface (FDDI) is a token passing network which can transmit at 100mbits/second at a distance of up to two kilometers. FDDI has been around since the mid-1980s and is presently deployed as both a backbone and in workgroups using unshielded twisted pair or fiber optic cable. Like ATM, FDDI provides communication services and acts as a traffic gathering system.

FDDI feeds a Distributed Queue Dual Bus (DQDB) which is used in Metropolitan Area Networks (MAN) to link LANs throughout a large geographical area. The DQDB topology includes two parallel runs of cable (typically fiber optic) linking each node on the system. One ring acts as the primary data path and the second ring acts as a backup. Should one cable ring fail, the primary and secondary rings bridge together at the closest node to create a single ring.

FDDI Normal Operation





A derivative of FDDI is FDDI 2 which adds circuit switched services to the normally packet switched technology in order to support isochronous traffic such as real time audio and video.

Key Points To Remember

- The three most common types of LAN architecture are Ethernet, Token Ring, and ARCnet.
- Ethernet uses the CSMA/CD access method.
- Token Ring and ARCnet use a token passing access method
- Fast Ethernet, also known as 100baseT, transits at 100 megabits per second.
- Their cable media; Thinnet, Thicknet and Twisted Pair commonly distinguish Ethernet networks.
- ISDN is an example of a Circuit Switched Network.
- Circuit Switched Networks are economical if a dedicated LAN-to-LAN connection is not needed.
- Packet Switched Networks include X.25, frame relay, and cell relay technologies.
- The major appeal of Packet Switched Services is their flexible multipoint capabilities.